Arizona
Department of Transportation

WORKBOOK

for

CHIP SEAL COAT INSPECTION
(Course Number 303)

a training course developed
for the

ARIZONA DEPARTMENT OF TRANSPORTATION
Phoenix, Arizona

by

ROY JORGENSEN ASSOCIATES, INC.
Gaithersburg, Maryland

Last revised by ADOT on August 25, 2003

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Directions to Workbook Users

Chip Seal Coat Inspection (Course Number 303) is one in a series of courses on inspection and quality control for bituminous highway construction. Other courses in the series include:

- Field Sampling and Testing for Bituminous Construction (Course 301);
- Prime, Flush and Tack Coats Inspection (Course Number 302);
- Asphaltic Concrete Plant Inspection (Course 304); and
- Asphaltic Concrete Paving Inspection (Course 305).

This course is designed primarily for highway construction inspection personnel, but it also can be used in training other personnel.

This Workbook is to be used in conjunction with a videotape presentation, discussion sessions with the trainee's instructor or supervisor, and other materials that make up the course. As sections of this Workbook are assigned, each trainee should:

1. read and study the material to review previously presented information and gain additional details;
2. complete the exercises and quizzes as they are provided;
3. check his answers against those provided following the exercise or quiz;
4. review the material as needed to correct and clarify any incorrect answers; and
5. discuss any areas that are still not clearly understood with his instructor or supervisor.

Each trainee should be provided with his own copy of this Workbook so that he can write in it and keep it for future reference and review.

This course is based primarily on the standards and methods established in the following Arizona Department of Transportation reference documents:

- Section 404, "Bituminous Treatments," in the *Standard Specifications for Road and Bridge Construction;* and
- Section 404, "Bituminous Treatments," in the *Construction Manual.*

Notes

From Discussion Period

Section One: Introduction And Preparations
Section 404

A chip seal coat is a single application of bituminous material applied to an existing bituminous surface and followed immediately by cover aggregate.

There is also a double application seal coat (chip seal and fog coat) stored specification 404 DBSC.

The primary purposes of chip seal coats are to:

- provide a waterproof seal,
- extend the life of the pavement by:
  - sealing dry or brittle old surfaces, and
  - by sealing newer pavements from aging elements; and
- improve or provide a skid-resistant riding surface.

The basic steps involved in single chip seal coating are:

1. preparing for the treatment,
2. applying the bituminous material,
3. applying the cover aggregates,
4. rolling the surface,
5. constructing joints, and
6. curing the treatment and cleaning up.

Equipment and Materials

The equipment and materials used in chip seal coating are summarized below.

Equipment

The equipment used includes:

- **certified scales** – for weighing cover aggregate;
- **cleaning equipment**:
  - for cleaning the surface before application, constructing joints, and removing loose aggregates after application, and
  - including power brooms (capable of cleaning without gouging the surface) as well as hand brooms and shovels;

- an **asphalt distributor** – for application of the bituminous material;[1]
- **aggregate haul trucks** – to provide supply of cover aggregates:
  - equipped for positive hookup with spreader and an apron long enough to avoid spills, and
  - in sufficient numbers to provide continuous supply;
- an **aggregate spreader –** that is:
  - self-propelled,
  - continuous feeding,
  - capable of positive hookup with trucks,
  - with pneumatic tires (not tracks) mounted on two axles,
  - capable of uniform distribution from 4 to 40 pounds per square yard (2.15 to 21.5 kilograms per square meter);
- a **patch truck** – to provide cover aggregates for spot hand work; and
- **pneumatic rollers** – that are:
  - an oscillating type (no wobble-wheel),
  - capable of up to 90 pounds per square inch (254.5 kilograms per square centimeter) of tire pressure,
  - capable of at least 2,000 pounds (900 kilograms) per tire operating weight,
  - ballasted and operated in accordance with the manufacturer's specifications, and
  - in sufficient numbers to cover the full width of the treatment in one pass – recommended roller minimum width 4 feet (1.2 meters).

It must be emphasized that effective chip seal coat operations require extensive coordination of the equipment so that the various equipment units function as a team. One breakdown can throw the operation out of balance and force all work to stop.

[1] For more detailed information on distributor requirements and operations, see the course **Prime, Flush and Tack Coats Inspection** (Course 302)

Materials

The materials used in chip seal coats are:

- **bituminous material** – as the binder:

  usually Cationic Emulsified Asphalt, type CRS-2 (unless otherwise specified).
- **cover aggregates** – as the skid-resistant riding surface:
  - consisting of clean sand, crushed gravel, or crushed rock,
  - with proper moisture content (wet but free of surface water, when used with emulsions),
  - free of contaminants (clay, synthetic, organic, or other foreign material), and
  - meeting the required characteristics summarized in the table below.

Characteristic	Specification
Gradation, % passing:	
⅜" sieve (9.375 millimeters)	100%
#4	0-25%
#8	0-5%
#200	0-2.0%
Loss on Abrasion:	
at 100 revolutions	9% max.
at 500 revolutions	40% max.
Limestone/% Carbonates	30% max.
Crushed Faces	70% min.
Flakiness Index	25% max.
Bulk Specific Gravity	2.30-2.85%

Preparations

Preparations for chip seal coat operations include:

- holding a pre-job conference with the contractor,
- establishing safe traffic control,
- scheduling the operations within specified seasonal and weather limitations,
- developing the chip seal coat design,
- preparing the surface to be treated, and
- checking equipment readiness.

Pre-Job Conference

In addition to such topics of discussion as the contractor's work plan and traffic control measures, the methods to be used in constructing joints are discussed at the pre-job conference for the Project Engineer's approval.

Traffic Control

As with other surface treatments, chip seal coat operations usually require full or partial closure of the road to traffic. Not only must the chip seal coat be protected from traffic, but also loose flying aggregates can be particularly hazardous to traffic.

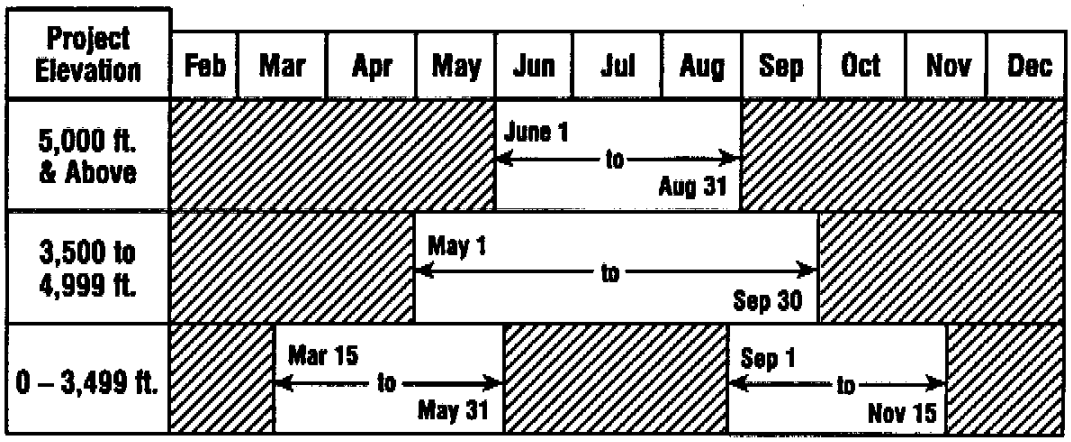
Seasonal and Weather Limitations

The basic weather limitations for chip seal coats are:

- the surface must be dry, and
- the surface temperature must be at least 85° F (29° C).

Generally, the surface temperature is taken in the sun – or in a spot that accurately represents the major portion of the area to be sealed.

In order to meet these basic limitations, chip seal coats are generally applied only during certain seasons depending on the average elevation of the project, as shown in the chart on page 7.



Notice that although there is no maximum temperature specified for chip seal coat operations, the hottest summer months at lower altitudes are also excluded from the chip seal coat season. Excessive heat can accelerate the curing of the treatment and allow aggregates to become dislodged during brooming.

Chip Seal Coat Designs

The basic objective of any chip seal coat design is to balance the asphalt and aggregates so that 50 to 70 percent of the voids between aggregates are filled as shown below:

Generally, depending on the condition of the existing surface:

- 50 percent may be adequate for heavy traffic, and
- 70 percent may be needed for lighter traffic.

If the asphalt and aggregates are *not* balanced:

- not enough asphalt – aggregates will be dislodged,
- not enough aggregate – gaps and bare spots are left,
- too much asphalt – aggregates are covered and asphalt bleeds, and
- too much aggregate – wasted, loose aggregate.

The chip seal coat design is specified by the *Standard Specifications* (404-3.14).

Surface Preparations

The last preparatory step is to prepare the surface. This includes:

- inspecting the surface for any defects that could affect the stability or smooth riding surface of the treatment,
- repairing any such defects well in advance,
- cleaning the surface of any loose or unstable material with power brooms and hand tools, and
- removing any spilled asphalt or oil that will hinder the adhesion of the treatment.

Equipment Readiness

As previously mentioned, chip seal coat operations require closely coordinated team work of the various pieces of equipment. Before the work begins, the inspector should check:

- the availability and proper operation of the equipment, and
- the number of equipment units for balanced operations.

Before work begins, the inspector also should check the certification of the weigh scales to be used in weighing the cover aggregate.

Section One Quiz

1. The three primary purposes of chip seal coats are to:

   a. _____

   b. _____

   c. _____

2. For which of the following types of equipment would *two or more* units usually be needed? (Circle one or more)

   a. power broom

   b. asphalt distributor

   c. haul truck

   d. aggregate spreader

   e. patch truck

   f. pneumatic roller

3. Which of the following types of bituminous materials is used for chip seal coats unless otherwise specified? (Circle one or more)

   a. asphalt cement

   b. liquid (cutback) asphalt

   c. emulsified asphalt

   d. recycling agent

4. The primary objective in any chip seal coat design is to balance the asphalt and aggregates so that... (Circle one)

   a. …70% to 100% of all voids are filled.

   b. …50% to 70% of all voids are filled.

   c. …20% to 50% of all voids are filled.

   d. …10% to 20% of all voids are filled.

5. If there is:
   a. not enough asphalt, the aggregates will _____
   _____
   b. too much asphalt, the aggregates will _____
   _____

6. Cover aggregates for a chip seal coat have been tested and found to have the characteristics summarized below:

- Gradation:

Passing	⅜-inch sieve (9.375 millimeters)	100%
	#4	21%
	#8	9%
	#200	1.8%

- Loss on Abrasion:

at 100 revolutions	6%
at 500 revolutions	27%

- Limestone 22%
- Crushed Faces 38%
- Flakiness Index 42%

The material must be rejected. Using the chart shown on page 5, identify three reasons why:

a. _____
b. _____
c. _____

7. The basic weather limitations for chip seal coats are:

   a. the surface must be _____ , and

   b. the surface temperature must be _____ .

8. In preparing the surface for a chip seal coat, any spilled oil or asphalt should be:

   _____
   _____

Section One Quiz Answers

1. a. provide a waterproof seal
   b. extend pavement life
   c. improve or provide skid-resistant surface

2. a. power brooms (to the extent that they are needed in initial cleaning, joint cleaning and final cleanup)
   b. asphalt distributor (optional) for continuous operation
   c. haul trucks
   d. pneumatic rollers

3. a. emulsified asphalt

4. b. 50%-70% of all voids are filled.

5. a. become dislodged
   b. be covered by the asphalt

6. a. too much material passed the #8 sieve
   b. the crushed faces are too low
   c. the flakiness index is too high

7. a. dry
   b. at least 85° (29° C)

8. removed

Notes

From Second Discussion Period

Section Two: Chip Seal Coat Operations

This section reviews chip seal coat operations in terms of:

- applying bituminous material,
- applying cover aggregates,
- rolling the surface,
- constructing joints, and
- curing and cleaning up.

Bituminous Material Application

The application of the bituminous material for a chip seal coat is similar to the application for other treatments in terms of such basic inspection points as:

- determining in advance:
  - the quantity of asphalt in the distributor; and
  - the specified application rate;
- the correct angle and end treatment of the spray bar nozzles;
- the proper spray bar height; and
- starting, maintaining, and stopping the spray for a uniform application.[2]

The key points to watch for in the asphalt application for chip seal coats are:

- the proper temperature for the type and grade of material being used (for example: 125° -185° F (52° - 85° C) for cationic emulsion, type CRS-2) (Sec. 1005),
- the proper application rate as specified in the Special Provisions or as directed by the Engineer, and
- the bituminous material should be uniformly applied in one application.

[2] For more specific details, review the section on "Distributor Operations" in the course on **Prime, Flush and Tack Coats Inspection** (Course 302).

After the first thousand feet (300 meters) or so of spray, you should check and record the actual application rate by:

1. calculating the quantity of asphalt used by:
   - determining the quantity left in the distributor, and
   - subtracting from the quantity at the start;
2. multiplying the width in feet (meters) times the length in feet (meters) and divided by 9 to determine the square yards covered (width times length determines square meters); and
3. dividing the asphalt used by the square yards (meters) covered to determine the actual rate of application – in gallons/yard^2 (liters/meters^2).

Then periodically recheck and record the application rate throughout the operation.

Cover Aggregate Application

As the cover aggregates are delivered by the haul trucks to the spreader, the inspector should watch for:

- contamination of the cover aggregates by oversized or foreign materials;
- the proper aggregate moisture content for the type of bituminous material used - for emulsified asphalts, it should be wet, but free of surface water;
- proper delivery to the spreader including:
  - straight alignment to avoid spills,
  - no bumping or pushing of the spreader, and
  - positive hookup with the spreader; and
- proper procedures by the truck drivers to include avoiding:
  - driving on uncovered asphalt,
  - speeds over 15 mph (24 kph),
  - driving in the same tracks as the previous truck (as much as possible),
  - sudden or excessive turning or braking, and
  - lining up behind the spreader so they block rollers from rolling immediately behind the spreader.

The aggregate spreader should operate as close as safely possible behind the distributor so that the aggregates are placed before the asphalt breaks. Ideally, this distance should be about 25 to 50 feet (7½ to 15 meters).

Key points to watch for in spreading the cover aggregates are:

- the aggregates should overlap beyond the edge of the asphalt;
- complete and uniform coverage must be achieved;
- a slight excess of aggregates is better than insufficient coverage:
  - particularly where the wheels of the spreader and haul trucks will pass, and
  - the excess can be removed later;
- the spreader should never be allowed to become completely empty;
- hand work from the patch truck is done quickly and only for small isolated spots – before rolling; and
- the cover material should be applied at a rate of approximately 0.01 cubic yards per square yard. However, the Engineer will specify the exact rate.

You must check the application rate of the cover aggregates by calculating the pounds per square yard of aggregate used (delivery ticket weights divided by area covered) for each load and total area covered.

Rolling

Rolling must start as close as possible (with some allowance for haul truck access to the spreader) behind the spreader so that the cover aggregates are embedded into the emulsion before it breaks.

Before and during rolling, the inspector must:

- see that there is a sufficient number of pneumatic rollers used to cover the full width of the treatment in one pass,
- see that at least three passes are made by each roller, and
- inspect the surface during rolling for proper embedment.

Additional rollers may be needed to keep the rolling operation up with the spreading operation. At the end of a run, the aggregate spreader must be moved off the area so that the rollers can roll through the end before the emulsion breaks.

Joint Construction

The methods to be used in constructing joints must be reviewed and approved by the Project Engineer before operations begin.

Transverse Joints

Transverse joints are constructed:

- at the end of a continuous run of the treatment,
- at intersections, and
- at existing pavements and structures.

The basic procedures for constructing a transverse joint are outlined below.

At the end of the first run:

1. The asphalt spray is shut off quickly and completely for a clean edge with:
   - the distributor maintaining its speed past the end, and
   - **no** "blowing" off of the asphalt allowed on the pavement.
2. The spreader runs the aggregate past the end of the asphalt (and gets out of the way of the rollers).
3. The rollers roll through the end of the aggregates.
4. The loose, excess aggregates are removed before the next run is started (but after the emulsion has broken).

At the start of the next run:

5. Paper is placed at the joint to shield the previous run.
6. The distributor achieves the desired speed and starts spraying on the paper (and the paper is removed).
7. The spreader achieves its desired speed and starts distributing aggregate before the start of the new section.
8. The excess aggregates are removed after rolling.

Longitudinal Joints

All chip seal coat longitudinal joints:

- must be "butt" joints:
  - with no overlap, and
  - at full application for both the asphalt and the aggregate;
- should be limited to as few as possible; and
- should be located as close as possible to the location of the lane lines.

The basic procedures for constructing a longitudinal joint are outlined below.

On the first run:

1. The distributor maintains a clean, uniform edge by:
   - using a special end-nozzle or shield along the edge, and
   - keeping the alignment as straight and uniform as possible.
2. Overlapping the cover aggregate beyond the edge of the asphalt.
3. Brooming off the loose, excess aggregates after rolling with about 6 inches (15 centimeters) of overlap with the broom on the first run.

On the adjacent run:

4. The distributor "fine-lines" the edge of the asphalt.
5. The spreader overlaps the aggregate onto the first section.
6. The loose, excess aggregates are removed after rolling and curing.

Curing and Cleanup

After the chip seal coat is applied, it must be allowed to cure before the loose aggregate can be removed.

Curing

In curing a chip seal coat:

- an initial traffic-free period is required:
  - for at least three hours (or longer, if weather slows curing), and
  - during which only work vehicles are allowed on the surface – and **only** at speeds of 15 mph (24 kph) or less; and
- a total curing period is required:
  - for at least twelve hours (an additional nine hours after the initial three),
  - for which a temporary centerline should be installed, using chip seal markers, and
  - during which traffic may be allowed on the surface – but at speeds no greater than 25 mph.

Final Cleanup

The primary objective in final cleanup is to remove loose, excess aggregates. If not removed, such material:

- would be unstable under the wheels of traffic, and
- could be a hazard to motorists when kicked up.

See that the final cleanup (brooming):

- is done after at least twelve hours but within thirty-six hours after rolling;
- is done by power brooms in such a manner that:
  - the loose material is removed, but
  - the brooming does not gouge the surface or dislodge aggregates;
- during hot weather is limited to relatively cool morning hours (before higher temperatures soften the bituminous binder);
- is carried out with extra care in urban areas to minimize throwing chips and raising dust (light watering may be needed for dust control); and
- is fully completed by picking up and removing any piles or windrows excess and loose aggregates.

You must inspect the chip seal coat closely for proper embedment of the aggregate both **during** and **after** final cleanup.

Section Two Quiz

1. Which of the following are key points in applying the bituminous material for a chip seal coat? (Circle one or more)
   a. proper angle of the spray bar nozzles
   b. correct spray bar height
   c. maintaining a uniform application rate
   d. application speed of 15 mph

2. The moisture content of cover aggregates used in chip seal coats using an emulsified asphalt should be _____ .

3. In applying cover aggregates, the edge of the aggregate application should be... (Circle one)
   a. … even with the edge of the asphalt.
   b. … kept in from the edge of the asphalt so that asphalt is exposed.
   c. ... overlapped beyond the edge of the asphalt.
   d. ... any of the above, because it makes no difference where the edge is located.

4. Which of the following is the most desirable approach regarding the application rate for cover aggregates? (Circle one)
   a. slightly more than specified
   b. slightly less than specified
   c. exactly as specified

5. In ending a continuous section of chip seal coating, which of the following practices is permissible? (Circle one or more)
   a. "blowing" the asphalt on the pavement
   b. running the aggregate past the end of the asphalt
   c. completely emptying the aggregate spreader
   d. parking the spreader at the end of the section so it is ready for the next section

6. During the initial traffic-free period of _____ hours, work vehicles may be allowed the surface, but only at speeds of _____ .

7. At which of the following points in chip seal coat operations should the inspector check for the proper embedment of the aggregates? (Circle one or more)

   a. immediately behind the spreader
   b. during rolling
   c. during final cleanup
   d. after final cleanup

Section Two Quiz Answers

1. a. proper angle of the spray bar nozzles
   b. correct spray bar height
   c. maintaining a uniform application rate

2. wet, but free of surface water

3. c. … overlapped beyond the edge of the asphalt.

4. a. slightly more than specified

5. b. running the aggregate past the end of the asphalt

6. at least 3 (hours), 15 mph

7. b. during rolling
   c. during final cleanup
   d. after final cleanup

Section Three: Documentation

This section summarizes the documentation involved in inspecting chip seal coat operations in terms of:

- measurement as the basis for payment,
- key information and events to be documented, and
- the records and reports used.

Measurement for Payment

The key measurements used as the basis for payments for chip seal coat operations are:

- tons (metric tons) of bituminous material applied, and
- cubic yards (meters) of cover material applied.

Additional information on measurement and payment for chip seal coats is provided in Section 404 of the *Standard Specifications*. Traffic control for chip seal coat operations is measured and paid for as specified in Section 701.

Key Information and Events

Some of the key information and events that need to be documented for chip seal coats is similar to that of any construction work including:

- routine information – such as the type of work being done, the project, the location, the time of the work, and the weather; and
- special events or problems – including any unusual conditions, instructions to the contractor, rejected work or materials, and corrective actions taken by the contractor.

Other key items of information and events that need to be documented specifically for chip seal coats include:

- certification of the transverse spread of the distributor;
- pre-certification and sampling of materials used in the treatment;

- quantities of material delivered to the project, including:
  - bituminous material, and
  - cover material;
- periodic checks of the spread rates achieved for the bituminous material and cover material; and
- daily and project-to-date totals of the pay quantities for the work, including:
  - gallons (liters) and tons (metric tons) of bituminous material applied, and
  - cubic yards (meters) of cover material applied.

Records and Reports

The principal records and reports used in documenting chip seal coat operations are:

- the Daily Diary,
- field notes,
- documents certifying the transverse spread of the distributor,
- documents on pre-certification and sampling of materials,
- the weight tickets and supplier's invoices for materials delivered to the project,
- spread rate calculations and documentation,
- the Traffic Control Record, and
- the Chip Seal Coat Survey.

Your instructor should be able to provide copies of examples of each of these records and reports.

Daily Diary

The Daily Diary serves as both a record and a report of all key events that occur during the day. All Daily Diaries are the property of the Department and serve as the foundation of all construction project records, so they must be maintained neatly and legibly in ink. They are generally a summary of key events and information, but they must provide sufficient detail so that other personnel can get an accurate picture of what happened each day.

The inspector must sign the Daily Diary and submit the copy to the Project Engineer at the end of each day. The items recorded in the Daily Diary include:

- such routine information as:
  - identification of the project,
  - the type of work being done,
  - the location of the work (stationing),
  - the times work is started and stopped,
  - weather conditions,
  - any important phone calls or other communications sent or received,
  - an inventory of the contractor's equipment and personnel resources being used on the work; and
  - contact Central Materials for verification of material certification,
- information on any special events or problems encountered such as:
  - any official visitors to the project,
  - unusual conditions that may affect the work,
  - the times and causes of any delays,
  - important discussions with the contractor and any specific instructions or orders given,
  - the rejection of any materials or work including the reasons for the rejection,
  - any changes, adjustments, or corrective actions by the contractor, and
  - any other information that may be relevant to any potential disputes or claims; and
- summaries of the pay quantities expended for the day's work and the project to date including:
  - the gallons (liters) and tons (metric tons) of bituminous material applied, and
  - the tons (metric tons) of cover material applied,
- field notes[3] for chip seal coats, used to record detailed technical information on the work including:
  - calculations used in determining such data as temperature-volume corrections, quantities of materials used and spread rates; and
  - any sketches or diagrams as may be needed to clarify such data as the calculations of spread rates for turnouts or other special areas.

[3] Because they are a key part of the Department's permanent record of the work, all field notes must be neat, clear, and accurate.

Distributor Certification

Before the work begins, the inspector must check the documentation that certifies that the distributor has been tested for transverse spread and found acceptable within the last six months. The distributor certification documentation should be checked before the operation begins and noted in the Daily Diary for the first day's operation.

Materials Pre-Certification and Sampling

The bituminous materials used in chip seal coats must be pre-approved and certified as to their type, grade, and required characteristics before they are delivered to the project. As bituminous materials are delivered to the project, the inspector:

- must collect the Certificate of Compliance or the Certificate of Analysis from the driver as the material is delivered to the project;
- notify the responsible ADOT lab to receive verification of the pre-approval; and
- have samples taken for residue testing.

For additional information see PPD 96-11.

The cover material used in chip seal coats is sampled at the crusher plant before it is delivered to the roadway. The basic sampling and testing requirements are summarized below and should be verified with the Arizona Testing Manual, Appendix C:

- at least one sample for each source is taken and tested for limestone content and abrasion loss;
- at least one sample per project is taken from the final stockpile and tested for crushed faces and flakiness index;
- at least one sample for every 300 tons (272 metric tons) of cover material is taken from the final stockpile and tested for gradation; and
- at least one sample for every 200 tons (181 metric tons) of cover material is taken from the trucks at the scale and tested for moisture content and unit weight.

For additional information on the specific sampling and testing procedures used, see the course **Field Sampling and Testing for Bituminous Construction** (Course 301).

Weight Tickets and Supplier's Invoices

Because chip seal coat operations are paid for on the basis of the cubic yards (meters) and tons (metric tons) of materials used (or as specified in the Special Provisions), the weight tickets for the cover aggregates and the supplier's invoices for the bituminous materials are two of the most critical documents involved in chip seal coat inspection.

As materials are delivered to the project, the inspector must collect the weight ticket or supplier's invoice that certifies the quantity of material delivered. The inspector should see that they are accurate and maintained as part of the project records. These quantities not only serve as the primary basis for payment, but also are used in determining the spread rates of the materials.

All weight tickets and supplier's invoices are submitted to the Project Engineer at the end of each day.

Spread Rate Calculations and Documentation

It is also extremely important for the inspector to calculate and document the actual spread rates of the materials throughout the project. Since the contractor is paid on the basis of the quantities of materials used, it is generally to his financial advantage to use more than is actually needed. However, too much asphalt acts as a harmful lubricant and too much cover material becomes loose waste material along the roadway. If the inspector does not closely monitor the actual application rates in relation to the designed application rates, the job can not only cost more than planned, but also be less effective than needed.

The Project Asphalt Report is a standard format specifically designed to record, calculate and report the quantities and spread rates of bituminous material used in chip seal coats and other bituminous treatments. The following outline is provided as a step-by-step guide for using the Project Asphalt Report to effectively control and document the spread rate of asphalt.

1. Such **basic information** as the date, identification of the project, and the type, grade, supplier, and specified application rate of the asphalt are provided at the top.
2. **At the start** of operations, record:
   - the distributor number,
   - the air and surface temperature,
   - the starting station number,
   - the spray bar width,
   - the first reading of gallons (liters) of asphalt in the distributor, checked on a level surface, and
   - the temperature of the asphalt in the distributor.

3. Continually **check the spread rate**, by:
   - recording the end station number and calculating the area covered (length x width),
   - recording the second reading of gallons (liters) of asphalt in the distributor and subtracting this reading from the first for the (uncorrected) gallons *(liters)* used,
   - calculating the corrected gallons (liters) by using the appropriate asphalt temperature correction factor, and
   - calculating the actual spread rate by dividing the corrected gallons (liters) used by the area covered.
4. **Repeat** the documentation process throughout the day, particularly noting:
   - any changes of distributors or delivery of asphalt,
   - any changes in air temperature, and
   - any remarks.
5. **At the end of the day**, calculate:
   - the total area covered, total corrected gallons (liters) used and average application rate for the day;
   - the accumulative total area, gallons (liters) and average rate for the project to date; and
   - the tons (metric tons) of asphalt used by multiplying the corrected gallons (liters) by the appropriate gallon-per-ton (liters-per-metric ton) factor.

The spread rate of the cover material must be calculated, closely monitored, and documented throughout the day. A variety of different formats are currently in use for this purpose, but the key elements are basically the same, as outlined below.

1. **At the start** of the operation, record:
   - the time,
   - the station number,
   - the width of the treatment, and
   - the temperature of the surface.

2. **As cover material is delivered**, record:
   - the truck number,
   - the tons (metric tons) of cover material being delivered (from the weight ticket), and
   - the station number.

3. After at least **every fifth load**:
   - record the time, surface temperature, and station number; and
   - calculate and record:
     - the tons (metric tons) of dry[4] cover material used,
     - the area covered, and
     - the actual spread rate – by dividing the tons (metric tons) used by the area covered and converting tons/sq. yd. (metric tons/sq. meter) into lbs./sq. yd. (kilograms/sq. meter).
4. **At the end of each day**, calculate (for both the day and the project to date):
   - the total tons *(metric tons)* of cover material used,
   - the total area covered, and
   - the average application rate.

Using these basic spread-rate procedures, the inspector can know at any given time the quantities of the materials used on the project. With this knowledge he can control:

- the quality of the chip seal coat in relation to the specified application rates, and
- the quantities and costs of the project to date in relation to the total planned quantities and budget.

Traffic Control Record

A Traffic Control Record must be kept for each day's operations. It identifies the signs, channelizing devices, flagmen, pilot vehicles, and other traffic control devices used. It should also include:

- location diagrams and/or photographs of the actual installations,
- information on the scheduling and implementation of moving the devices to keep up with the operation, and
- information on any changes or deviations from the approved traffic control plan.

[4] When water is added to the cover material for use over emulsion, the weight of the added moisture in the material should be calculated (based on test results) and deducted from the total weight of the material. Check the contract documents for specific information on how to handle moisture content of the cover material.

Chip Seal Coat Survey

At the end of the project, a Chip Seal Coat Survey must be submitted. Although it is an end-of-project summary, the data needed to complete it must be accurately recorded from the **start** of the project.

The Chip Seal Coat Survey includes:

- the existing surface conditions by location;
- the ambient and surface temperatures for each day's operation;
- the general weather conditions;
- the spread rates for the asphalt and the cover aggregates including:
  - the maximum and minimum rates (identified by stations), and
  - the average rates; and
- the actual gradation of the cover material.

Appendix
Temperature-Volume Corrections for Asphaltic Materials

Group 0 – Specific Gravity at 60° F Above 0.966

LEGEND: t = observed temperature in degrees Fahrenheit
M = multiplier for correcting asphalt cement volumes to the basis of 60° F

t	M	t	M	t	M	t	M	t	M	t	M	t	M	t	M	t	M	t	M
0	0.0211	50	1.0035	100	0.9861	150	0.9689	200	0.9520	250	0.9352	300	0.9187	350	0.9024	400	0.8864	450	0.8705
1	1.0200	51	1.0031	101	0.9857	151	0.9686	201	0.9516	251	0.9349	301	0.9184	351	0.9021	401	0.8861	451	0.8702
2	1.0204	52	1.0028	102	0.9854	152	0.9682	202	0.9513	252	0.9346	302	0.9181	352	0.9018	402	0.8857	452	0.8699
3	1.0201	53	1.0024	103	0.9851	153	0.0969	203	0.9509	253	0.9342	303	0.9177	353	0.9015	403	0.8854	453	0.8696
4	1.0197	54	1.0021	104	0.9847	154	0.9675	204	0.9506	254	0.9339	304	0.9174	354	0.9011	404	0.8851	454	0.8693
5	1.0194	55	1.0017	105	0.9844	155	0.9672	205	0.9503	255	0.9336	305	0.9171	355	0.9008	405	0.8848	455	0.8690
6	1.0190	56	1.0014	106	0.9840	156	0.9669	206	0.9499	256	0.9332	306	0.9167	356	0.9005	406	0.8845	456	0.8687
7	1.0186	57	1.0010	107	0.9837	157	0.9665	207	0.9496	257	0.9329	307	0.9164	357	0.9002	407	0.8841	457	0.8683
8	1.0183	58	1.0007	108	0.9833	158	0.9662	208	0.9493	258	0.9326	308	0.9161	358	0.8998	408	0.8838	458	0.8680
9	1.0179	59	1.0003	109	0.9830	159	0.9658	209	0.9489	259	0.9322	309	0.9158	359	0.8995	409	0.8835	459	0.8677
10	1.0176	60	1.0000	110	0.9826	160	0.9655	210	0.9486	260	0.9319	310	0.9154	360	0.8992	410	0.8832	460	0.8674
11	1.0172	61	0.9997	111	0.9823	161	0.9652	211	0.9483	261	0.9316	311	0.9151	361	0.9889	411	0.8829	461	0.8671
12	1.0169	62	0.9993	112	0.9819	162	0.9648	212	0.9479	262	0.9312	312	0.9148	362	0.8986	412	0.8826	462	0.8668
13	1.0165	63	0.9990	113	0.9816	163	0.9645	213	0.9476	263	0.9309	313	0.9145	363	0.8982	413	0.8822	463	0.8665
14	1.0162	64	0.9986	114	0.9813	164	0.9641	214	0.9472	264	0.9306	314	0.9141	364	0.8979	414	0.8819	464	0.8661
15	1.0158	65	0.9983	115	0.9809	165	0.9638	215	0.9469	265	0.9302	315	0.9138	365	0.8976	415	0.8816	465	0.8658
16	1.0155	66	0.9979	116	0.9806	166	0.9635	216	0.9466	266	0.9299	316	0.9135	366	0.8973	416	0.8813	466	0.8655
17	1.0151	67	0.9976	117	0.9802	167	0.9631	217	0.9462	267	0.9296	317	0.9132	367	0.8969	417	0.8810	467	0.8652
18	1.0148	68	0.9972	118	0.9799	168	0.9628	218	0.9459	268	0.9293	318	0.9128	368	0.8966	418	0.8806	468	0.8649
19	1.0144	69	0.9969	119	0.9795	169	0.9624	219	0.9456	269	0.9289	319	0.9125	369	0.8963	419	0.8803	469	0.8646
20	1.0141	70	0.9965	120	0.9792	170	0.9621	220	0.9452	270	0.9286	320	0.9122	370	0.8960	420	0.8800	470	0.8643
21	1.0137	71	0.9962	121	0.9788	171	0.9618	221	0.9449	271	0.9283	321	0.9118	371	0.8957	421	0.8797	471	0.8640
22	1.0133	72	0.9958	122	0.9785	172	0.9614	222	0.9446	272	0.9279	322	0.9115	372	0.8953	422	0.9794	472	0.8636
23	1.0130	73	0.9955	123	0.9782	173	0.9611	223	0.9442	273	0.9276	323	0.9112	373	0.8950	423	0.9791	473	0.8633
24	1.0126	74	0.9951	124	0.9778	174	0.9607	224	0.9439	274	0.9273	324	0.9109	374	0.8947	424	0.8787	474	0.8630
25	1.0123	75	0.9948	125	0.9775	175	0.9604	225	0.9436	275	0.9269	325	0.9105	375	0.8944	425	0.8784	475	0.8627
26	1.0119	76	0.9944	126	0.9771	176	0.9601	226	0.9432	276	0.9266	326	0.9102	376	0.8941	426	0.8781	476	0.8624
27	1.0116	77	0.9941	127	0.9768	177	0.9597	227	0.9429	277	0.9263	327	0.9099	377	0.8937	427	0.8778	477	0.8621
28	1.0112	78	0.9937	128	0.9764	178	0.9594	228	0.9426	278	0.9259	328	0.9096	378	0.8934	428	0.8775	478	0.8618
29	1.0109	79	0.9934	129	0.9761	179	0.9590	229	0.9422	279	0.9256	329	0.9092	379	0.8931	429	0.8772	479	0.8615
30	1.0105	80	0.9930	130	9.7558	180	0.9587	230	0.9419	280	0.9253	330	0.9089	380	0.8928	430	0.8768	480	0.8611
31	1.0102	81	0.9927	131	0.9754	181	0.9584	231	0.9416	281	0.9250	331	0.9086	381	0.8924	431	0.8765	481	0.8608
32	1.0098	82	0.9923	132	0.9751	182	0.9580	232	0.9412	282	0.9246	332	0.9083	382	0.8921	432	0.8762	482	0.8605
33	1.0095	83	0.9920	133	0.9747	183	0.9577	233	0.9409	283	0.9243	333	0.9079	383	0.8918	433	0.8759	483	0.8602
34	1.0091	84	0.9916	134	0.9744	184	0.9574	234	0.9405	284	0.9240	334	0.9076	384	0.8915	434	0.8756	484	0.8599
35	1.0088	85	0.9913	135	0.9740	185	0.9570	235	0.9402	285	0.9236	335	0.9073	385	0.8912	435	0.8753	485	0.8596
36	1.0084	86	0.9909	136	0.9737	186	0.9567	236	0.9399	286	0.9233	336	0.9070	386	0.8908	436	0.8749	486	0.8593
37	1.0081	87	0.9906	137	0.9734	187	0.9563	237	0.9395	287	0.9230	337	0.9066	387	0.8905	437	0.8746	487	0.8590
38	1.0077	88	0.9902	138	0.9730	188	0.9560	238	0.9392	288	0.9227	338	0.9063	388	0.8902	438	0.8743	488	0.8587
39	1.0074	89	0.9899	139	0.9727	189	0.9557	239	0.9389	289	0.9223	339	0.9060	389	0.8899	439	0.8740	489	0.8583
40	1.0070	90	0.9896	140	0.9723	190	0.9553	240	0.9385	290	0.9220	340	0.9057	390	0.8896	440	0.8737	490	0.8580
41	1.0067	91	0.9892	141	0.9720	191	0.9550	241	0.9382	291	0.9217	341	0.9053	391	0.8892	441	0.8734	491	0.8577
42	1.0063	92	0.9889	142	0.9716	192	0.9547	242	0.9379	292	0.9213	342	0.9050	392	0.8889	442	0.8731	492	0.8574
43	1.0060	93	0.9885	143	0.9713	193	0.9543	243	0.9375	293	0.9210	343	0.9047	393	0.8886	443	0.8727	493	0.8571
44	1.0056	94	0.9882	144	0.9710	194	0.9540	244	0.9372	294	0.9207	344	0.9044	394	0.8883	444	0.8724	494	0.8568
45	1.0053	95	0.9879	145	0.9706	195	0.9536	245	0.9369	295	0.9204	345	0.9040	395	0.8880	445	0.8721	495	0.8565
46	1.0049	96	0.9875	146	0.9703	196	0.9533	246	0.9365	296	0.9200	346	0.9037	396	0.8876	446	0.8718	496	0.8562
47	1.0046	97	0.9871	147	0.9699	197	0.9530	247	0.9362	297	0.9197	347	0.9034	397	0.8873	447	0.8715	497	0.8559
48	1.0042	98	0.9868	148	0.9696	198	0.9526	248	0.9359	298	0.9194	348	0.9031	398	0.8870	448	0.8712	498	0.8556
49	1.0038	99	0.9864	149	0.9693	199	0.9523	249	0.9356	299	0.9190	349	0.9028	399	0.8867	449	0.8709	499	0.8552